

FIVE-YEAR PLAN FOR SPACE RESEARCH

F. K. Schroeder

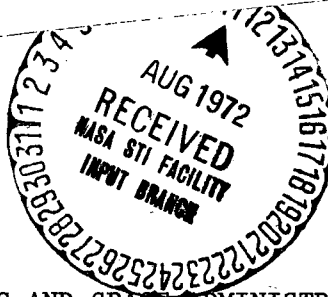
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FIVE-YEAR PLAN FOR SPACE RESEARCH^{*}

ABSTRACT. This report summarizes the experiments for existing and planned research programs, as well as other proposed experiments, in which the respective research organizations have a direct interest for future accomplishment.

INTRODUCTORY REMARKS

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In the following summary are listed the various research programs and proposed experiments in the fields of extra-terrestrial research and of biophysics, which were compiled in 1971. This tabulation should provide an overview both of those programs already being implemented, as well as of the proposals and desires for additional experiments by the research organizations active in the domain of space research. An additional section of this report delineates various proposals and suggestions for initial developmental efforts, systems studied and facilities design approaches, which will serve to provide incentive for research task development and support, and are directed to the DFVLR^{***} and the space industry.

The compilation under discussion should prove to be adequate as a basis for the implementation of suggestions for programs, projects and tasks involved in a moderately budgeted plan for space research by the Federal Republic of Germany. The AWF^{***} recommends this list be reviewed on a yearly

^{*} Combined Space Research Association of the Max Planck Institutes for Physics and Astrophysics, for Aeronomy and for Nuclear Physics, and the German Research and Development Center for Aeronautics and Astronautics (DFVLR), Inc.

^{**} Numbers in the margin indicate pagination in the original foreign text.

^{***} Translator's Note: Abbreviations are defined at the end of this section.

basis and supplemented as required. This first version is submitted to the respective agencies with the request that it be reviewed for validity and completeness concerning current thinking, and that the information contained herein be supplemented.

The subdivision of the description of each proposed experiment into 12 columns should present extensive information about it in the most condensed format. This should permit comparisons between related proposals and facilitate initial consideration for task proposals. Comments as to the utility of this arrangement are invited and any suggestions for change are welcome.

EXPLANATION OF ORGANIZATION OF REPORT

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The proposals are classified according to the following fields of research: Atmosphere/Ionosphere, Magnetosphere, Solar/Interplanetary Space, Astrophysics/Astronomy, Biophysics/Biology. A better overview is obtained by means of this initial, unrefined subdivision into a few small groups of proposals. The concept of selecting an arrangement to make possible the unique classification of a given proposal within any one subdivision is the basis of this approach, but unfortunately this could not be fully achieved by grouping into these fields of research.

Column 1: Sequential numbering of proposals within a given field of research.

Column 2: Details concerning the technique by which it is intended to carry out a given proposal.

Column 3: Reference to an existing or planned program, associated program or project, portions of which make up the proposal, i.e., specifying the item number associated with another proposal, which should be carried out together with the proposal considered (in the same payload, in a follow-on or companion program, as a ground

observation in support of the task, and the like).

Column 4: Description of primary scientific area of investigation, i.e., that scientific problem area for the investigation of which the proposal will make a distinct contribution.

Column 5: Data measurement tasks and immediate scientific goals of the proposed experiment (refer also to column 7 and 8). Insofar as the suggesting agency proposal does not itself intend to carry out an experiment, an applicable reference should be made here. A pertinent remark should be made in column 10, as required, if program participation is intended without that agency's own equipment hardware. If the proposal relates to a cooperative experiment to be jointly carried out with other agencies, then the extent of the individual participation should also be indicated with additional remarks in columns 8 and 10. In this way, the scope of any individual contribution to the overall program can be properly identified.

Column 6: a) Details on the organization submitting the proposal (refer to list below for abbreviations used).
b) Name of suggesting agency or researcher (for approved proposals).

Column 7: Details on which physical parameters will be investigated as well as the observable limits and accuracy of the measurements made; additional details on spatial resolution, precision of timing and other important data-gathering capabilities of the instrumentation used, preferred orientation of instruments used for making observations, special timing requirements, etc.

Column 8: a) Nomenclature of instrumentation used (or designation of measurement technique used, in particular as this is related to the major components of the instrumentation system); if

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possible, any special distinguishing characteristics of the equipment (such as the magnitude of the effective area of a spark chamber).

- b) Details on whether developmental efforts are still in the planning stage, or if this has already been completed, or if the instrumentation used is state-of-the-art equipment; or data such as "delivery time for equipment procurement is (months)," where an estimate is desired for the number of months required from start of development through completion of operationally functioning equipment.
- c) These remarks apply to launch flight parameters. Here it is desired to obtain appropriate details concerning telemetry or tracking installations to be used for ground observations associated with launch activities (i.e., external power requirements, communications support needs, shipping weight, etc. for transportable systems). Supplementary information is requested on other needs which must be fulfilled at the launching site, such as availability of liquid gases or other resources to aid in launch support.

- Column 9:
- a) Details on desired flight path in which measurements will be taken, i.e., orbital parameters such as apogee, perigee, inclination, etc.
 - b) Data-gathering interval for a particular portion of a mission, e.g., for launch sequence of the booster vehicle and its stages, a statement such as "four minutes, up through 80 kilometers altitude." For continuous or periodically repeated measurements made during the mission profile, the duration of the overall mission is required (for instance, in the case of a satellite, its expected lifetime should be given).
 - c) Details on desired orientation of a satellite in its orbit, accuracy of its orientation, desired changes in orientation,

permissible rates of acceleration.

- d) Details on desired launch window and launch site, as well as times and places for conducting observations and other mission support activities (e.g., salvage operations, parachute recovery and other recovery activities, launch sequence for several consecutive operations, etc.).

Column 10: Refer to explanation for Column 5.

Column 11: Details on type of experiment (if applicable, indicate item number insofar as the proposal for the experiment is already contained in this list). Also indicate if the suggesting agency itself is interested in carrying out the experiment. Concerning subparagraph b): this should list those proposals for experiments which do not fall into the category under subparagraph a). These additional experiments may take place either simultaneously with the main proposed experiment, or at different times. The agency responsible for carrying out the proposal should be indicated, as well as the technicological area of application (corresponding to Column 2).

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Column 12: Information is desired here which should be taken into consideration in order to place proposals into the proper sequence within a given program schedule. For a schedule that already exists for the main proposal to a program, the following data should be indicated:

- a) For example, the type of carrier vehicle for the experiment (balloons, aircraft, high altitude research rockets, satellites, space probes, etc.).
- b) Authorization for the project, in particular, the year in which a given scientific task is scheduled to begin.
- c) Timeframe for project completion (including time required for data processing and evaluation); if necessary for clarification,

remarks should be made as: "This project will be continued until ... (year)."

- d) Year in which scientific interest in the accomplishment of a given proposal most likely will be discontinued.

Insofar as a program is not yet fully defined, the following data should be indicated:

- a) As above.
- b) Estimated year in which a project must be begun in order to complete it within a timeframe that is limited by d) above, or year in which it is desired that the task be begun.
- c) Estimated year for project termination, or a remark such as "Continuation of this project is planned until ... (year)."
- d) As above.

Listed below are the abbreviations used in column 6, of the institutions and agencies which provided recommendations to the five-year plan for space research.

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ABR	Study Group for Biophysical Space Research, Frankfurt-on-Main
AEB	Institute for Astrophysics and Extra-terrestrial Research of the University of Bonn
AIT	Astronomical Institute of the University of Tübingen
APW	Study Group for Physics in Space Research, Freiburg-in-Breisgau
EPB	Department of Extra-terrestrial Physics, University of the Ruhr in Bochum
FEBF	Research Group for Extra-terrestrial Biology of the University of Frankfurt-on-Main
FIF	Fraunhofer Institute, Freiburg-in-Breisgau
-IBSH--	-Institute for Biophysics and Radiation Biology of the University of Hamburg

IGG	Institute for Geophysics of the University of Göttingen
IGMB	Institute for Geophysics and Meteorology of the Institute of Technology at Braunschweig
IHF	<u>Institute for Human Genetics at the University of Frankfurt-on-Main</u>
IKKI	Institute for Pure and Applied Physics at the University of Kiel
IPAO	Institute for Physics of the Atmosphere of the DFVLR, Oberpfaffenhofen
ISH	Institute for Radiation Biology at the Polytechnic Institute of Hannover
ISIM	Institute for Radiation Biology and Medical Applications of Isotopes at the University of Marburg
KIFKS	<u>Institute for Nuclear Physics of the Universities of Frankfurt, Kiel and Strassburg</u>
MIM	Meteorological Institute of the University of Munich, Department for Atmospheric Radiation and Satellite Meteorology
MPA	Max Planck Institute for Astronomy at Heidelberg-Königstuhl
MPB	Max Planck Institute for Biophysics at Frankfurt-on-Main
MPE	Institute for Extra-terrestrial Physics at the MPI for Physics and Astrophysics, Garching
MPIO	Institute for Ionosphere Physics at the MPI for Aeronomy, Lindau
MPK	MPI for Nuclear Physics, Heidelberg
MPS	Institute for Stratosphere Physics at the MPI for Aeronomy, Lindau
MPW	Division for Space Physics at the MPI for Aeronomy, Lindau
NUCMED	Clinic and Polyclinic for Nuclear Medicine, Radiology Center of the Philipps University, Marburg
PIB	Physical Institute of the University of Bonn
PIH	Second Physical Institute of the University of Heidelberg
RIF	Radiological Institute of the University, Freiburg i. B.
RSB	Radio Observatory of the University of Bonn

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I. ATMOSPHERE/IONOSPHERE

Concentrated, closely coordinated efforts in conjunction with support of the International Magnetospheric Survey (IMS) are encouraged, to include ground observations and use of high altitude research rockets. Emphasis is placed upon accomplishment in a time frame coinciding with the GEOS and HELIOS mission profiles for 1974-1976.

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
1	B	GEMOS-proposal	Atmospheric Physics	Program consisting of optical payloads for indirect radiometric probing of the atmosphere	a) MIM b) Bolle
2	R		Atmospheric Physics	Optical analysis of trace gases in the stratosphere, using absorption spectroscopy techniques (coronagraph equipment) in solar oriented rockets	a) MIM b) Bolle
3	R		Atmospheric Physics	Optical analysis of the distribution of water vapor in the mesosphere, using absorption spectroscopy methods in solar oriented rockets	a) MIM b) Bolle
4	R		Atmospheric Physics	Airglow measurements, using radiometric probes	a) MIM b) Bolle
5	S		Meteorology and Earth Sciences	<u>Meteorological Problems</u> 1. Types and distribution of clouds (using a 1.2-1.55 μ cloud photometer and an 11- μ cloud radiometer). 2. Temperatures at specified reference attitudes (using an infrared radiometer for vertical sounding through 6 different spectral regions). 3. Distribution of trace gases, in particular H ₂ O water vapor (at wavelengths of 49, 34 and 19 μ , and as correlated with 2 telemetry channels reserved for temperature measurements), and ozone O ₃ (at a wavelength of 9.6 μ). <u>Problems in Earth Science</u> Investigation of the usefulness of satellite observations in obtaining any evidence concerning identification of and differentiation between various lithological formations and structures (multispectral photographic recordings: photographic recording system in 4 spectral frequency bands between 0.5 and 1.1 μ , with a high-resolution infrared radiometer at 11 μ).	a) MIM and others b) Bolle
6	S			<u>Second Geophysical Satellite</u> 1. Measurement of temperature variations throughout the stratosphere (using a SISAM-interferometer)	a) MIM b) Bolle and others

T = ground observation F = high altitude aircraft; R = high altitude research rocket;
B = research balloon; S = satellite; P = space probe; RS = space station

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
		<p>a) 911 kilometers inclination of 99°</p> <p>b)</p> <p>c) one axis of satellite continually pointed towards the earth</p>			1/3

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
7	S T		<p>Sferics (Atmospheric Disturbances): Inferences concerning:</p> <p>a) Direction and distance from localized thunderstorms</p> <p>b) Number of lightning discharge in these thunderstorms, per unit of time</p> <p>c) Propagation characteristics of the wave guide between the earth and the ionosphere (frequency, distance, azimuth).</p>	<p>2. Investigation of radiated emissions from stratified layers of the atmosphere (leading to interferences on temperature distribution and distribution of trace gases throughout the upper atmosphere).</p> <p>3. Measurement of the concentration of ozone O_3 in the upper atmosphere (using an albedo measuring device in the ultra-violet region).</p> <p>4. Photometric analysis of cloud formations and investigation (through determination of the effective radiation temp.) of the earth's surface and oceans, using a wideband photometer/radiometer device.</p> <p>5. Spectral analysis, using Fourier-transform methods, of the radiated emission of the atmosphere.</p> <p>6. Global (synoptic) determination of variations in space and time of air density and air pressure in the atmosphere below 50 kilometers altitude, and of the distribution of aerosol particles below 80 km altitude (using an optical radar device).</p> <p>Statistical measurements of spectral amplitude and phase of sferic generated in the VLF radio region, as these parameters vary with angle of incidence. Use of methods developed by the Heinrich Hertz Institute of Berlin-Charlottenburg for support of a project for continuous ground observations carried out jointly in Japan, USA, Argentina and the Federal Republic of Germany</p> <p>a) Verification of global distribution of thunderstorm activity</p>	<p>a) RSB & HHI b) Volland</p>

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

[illegible]

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
8	R		<p>d) Average spectral intensity vs. frequency of lightning discharge, at its source.</p> <p>Tidal motion and planetary circulation of the thermosphere. Study of the structure of its formation and spreading, and variations with altitude, using a 3-dimensional spherical-dynamic model for various tidal and planetary waves in conjunction with theories of geomagnetic S_q-variations and of electric fields produced in the ionosphere.</p>	<p>The goal here is to achieve the best possible team effort with the aid of theoretical models for measurements made on flow patterns, density and composition of the thermosphere from an altitude between 80 and 200 kilometers. This approach takes into account the magnitude of the data to be measured, as theoretically expected according to its dependence on latitude. Flow pattern measurements will be taken daily during equally spaced intervals of time. The main interest here is to develop the best possible team effort between agencies, rather than an individual experiment.</p>	<p>a) RSB b) Volland</p>
9	R		<p>Systematic study of D- and lower F-layers of the ionosphere: space-temporal variations of its ionic composition; likewise for the presence of un-ionized trace gases. The role these variations play in ionic chemical processes in the ionosphere will also be studied.</p>	<p>Measurement of composition of and density of the positive and negative ions in the ionosphere; likewise for trace gases in their neutral state, such as O, O₃, CO₂, H₂O. Measurement of their space-temporal variations below 100 km altitude, using payloads recovered by parachute. In addition, measurements of the following characteristics are desired: electron density, overall ion density, temperature, turbulence.</p>	<p>a) MPK b) Krankowsky</p>
10	R S		<p>Transmission of radiation through the earth's atmosphere.</p>	<p>Measurement of solar radiation reflected from the earth's surface (intensity and polarization in various regions of visible light) and interpretation of these measurements (radiation propagation, influence of aerosol particles, etc.).</p> <p><u>First phase:</u> high altitude research rockets.</p> <p><u>Second phase:</u> satellite measurements.</p>	<p>a) EPB b) Giese</p>

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

[illegible]

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
11	R		Conservation of energy and propagation of radiation through the ionosphere, influence of the flux density of photo-electrons	Observations on flux density of photo-electrons and its dependence on incident radiation: 1. Measurement of photo-electron flux density by means of an electron spectrometer. 2. Measurement of incident radiation by means of an <u>EUV spectrometer</u> . 3. Use of mass spectrometer to determine composition of non-ionized gases. (Also: measurement of density and temperature of gases in the neutral state.)	a) APW b) Grabowski
12	R		Conservation of energy and propagation of radiation through the ionosphere, albedo reflection	Observations on airglow: measurement of the intensity and of the spectral distribution in the ultraviolet region of airglow phenomena. (Additionally, photometric analysis of certain emission lines of excited atoms and molecules in other spectral regions). Continued in satellite experiment item No. 12.	a) APW b) Grabowski
13			Dynamics of the ionosphere and thermosphere, experimental contributions to existing theory.	Measurement of turbulence of positive ions and of the electric field intensity, spectral analysis of certain lines in the ultraviolet region. (Additional measurements: turbulence of non-ionized gaseous matter and its density and temperature, density and temperature of ionic gases, turbulence of the electron cloud, intensity of the geomagnetic field. Simultaneous probe rocket launches at polar, middle and equatorial geomagnetic latitudes.	a) APW b) Grabowski
14	RR S		Radiation associated with the exosphere of the earth, energy transfer phenomena	Investigation of solar Lyman-alpha spectral emission and of the solar wind: 1. Ion chamber with and without absorption filter (Additionally: mass spectrometer) <u>Simultaneous</u> rocket and satellite launches.	a) IPAO b) Stätter

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
UV: resolution:	a) b) c) a) UV spectrometer b) c)	a) b) c) d) a) b) c) d)		a) Density and temp. of the neutral atmosphere	a) b) c) d) a) b) c) d)
H = 1216 A +1 A aperture angle about 10°	a) Ionization chamber + absorption chamber b) Further developmt. c) About 5 kg/about 5 W/about 5 dm ³ / <u>2000 bps</u>	a) Rocket alt. < 1000 km b) 20 min from 300 km alt. c) Spin-stabilized d) From Natal or Thumba a) Satellite in polar orbit at 500 km alt. b) 1 year c) Sun-oriented d) -	In collaboration w/ other agencies E.g., Naval Res. Lab. Blamont Univ. of Bonn	a) See column 5 b) 3 rocket launches, ionosondes a) Mass spectrometer	a) 1-2 launches, possibly with Javelin booster vehicle

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FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
15	R T		Investigation of the max. twilight effect of the tropical arc at 15° latitude; photo-ionic effects of the airglow.	Recording of the variation in altitude of optical emission radiated by atomic oxygen. (Additionally, electron density, low-energy electrons, mass spectrometer.) <u>Simultaneous</u> ground observations with photometric recorders and ionosondes.	a) IPAO b) Stätter
16	R		Interactions between the magnetosphere and ionosphere.	Investigation of plasma stability of spread-F ionospheric phenomena in equatorial regions. Study of reversal effect of the <u>electric field</u> occurring after sunset and conditions for spread-F phenomena.	a) MPE b) Haerendel, Hovestadt
17	R	RA Co-op	Measurements of electric fields at lower geomagnetic latitudes and trial application of new tracer elements. Follow-on program: Radiation emitted from charged particles trapped between geomagnetic conjugate points.	<u>Ion cloud experiments in Argentina.</u> Measurements of transverse electric fields, variation of electron density with altitude, yield of Europium and Lithium products by means of sublimation processes in the ionosphere. Follow-on program: measurement of electric field intensity along geomagnetic lines between conjugate points.	a) MPE b) Haerendel, Föppl
18	R	Continuation of the Natal program of 1970	Investigation of the equatorial electro-jet (EEJ): proof of the existence of the toroidal magnetic field system associated with the circulation pattern of the EEJ.	Synoptic survey to an accuracy of ± 2 gamma of the magnitude and direction of the intensity of the toroidal magnetic field by means of a high altitude research rocket passing through the E-layer of the ionosphere; the attitude of the rocket in flight must be so as to permit measurement of the aspect angle to the Sun with an accuracy of 2 mins, and of the angle between the Sun and the geomagnetic field to an accuracy of 1 min. The rotational frequency of the rocket about its axis must be determined to an accuracy of 4 microseconds. 1. Dual unit Förster probe with analog-to-digital data encoder. 2. Sun-seeking sensor. 3. Apparatus for measuring differences in angular position (goniometric measurements).	a) IGMB b) Musmann

T = ground observation; F = high altitude aircraft; R = high altitude research rocket; B = balloon; S = satellite; P = space sensor; RS = space station

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
1304, 6300, 7886, 8509 A ± 5 A ang. ap. $\leq 10^\circ$ Field of view restricted away from Sun	a) Photometer with interference filter b) Further developm. c) About 5 kg/about 5 W/about 10 dm ³ / ≤ 1000 bps	a) Measurements made between 80 and 300 km b) 4 mins. c) Spin-stabilized d) From Natal or Thumba, launch countdwn is 1 hour	E.g., PIB MPIO	a) electron density, spectrum of low-energy electrons, mass spectrometer b) Ground photometer, ionosonde	a) At least 2-3 launches, possibly with Black Brant V
E-Field: Volt. differential B: 100 V/m ⊥ B: 1 mV/m $n_e: 10^4-10^6/\text{cm}^3$ p: 5 eV - 5 keV	a) 1. Barium clouds 2. Impedance probe 3. E-field probe 4. Proton detector b) completed c)	a) 500 - 600 km b) 14 mins c) d) Launch from Thumba	1. Phys. Res. Lab. of India 2. Prof. Mozer of Univ. of Calif.	a) E-field probe with 2 booms, proton detector for 5 eV - 5 keV	a) 2 launches in 1972 with dual Hawk booster vehicle b) 1972 c) 1972
E-field: $n_e: 10^4 - 10^6/\text{cm}^3$	a) 1. Barium and europium clouds 2. Impedance probe b) Being tested c) 27 kg	a) 285 km (RIGEL) 500 km (CASTOR) b) 9 and 14 mins, resp., with observation of cloud formation c) d) Launches from Chanical (Argentina) starting in Oct., 1972	In conjunction with Nat'l Commission for Space Research of Venezuela		a) RIGEL, 3 launches 1972 b) 1972 c) Follow-on until 1972, also with CASTOR
Required Resolution of geomagnetic elements: $1:10^4 (\pm 2 \gamma)$	a) Two-element Förster probe b) c)	a) $H > 200$ km b) c) Spin-stabilized, unperturbed nuta-above 60 km alt. d) Measurements to be made 200-400 north or south of the magnetic equator (Natal, Thumba Addis Ababa)		a) Electron density, steady-state electric field b) Ground measurements on magnetic field of electro-jet (diurnal variations)	a) Four Nike-Apache or Iroquois (Niro) launches.

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
19	B	IMS & GEOS follow-on program in 1975/76	Supplementary experiment for GEOS in close collaboration with the SPARMO program. Contributions to inquiries concerning origin and fluctuations of electron flux density measured in the GEOS program.	4. Measurement of frequency of rotation (of rocket). (Additionally: electron density, measurements on steady-state electric field intensity). <u>Simultaneous</u> ground observations on geomagnetic field intensity at launch site and at geomagnetic equator. Measurements on the energy spectra and periodicity of x-ray bursts, for the purpose of establishing a relationship between measurements obtained in the GEOS orbit and other measurements of electronic discharge induced by x-rays.	a) MPS b) Pfozter
20	R	IMS & GEOS follow-on program in 1975/76	Supplementary experiment for GEOS to investigate various phases of perturbation effects (substorms) peculiar to geomagnetic disturbances.	Measurements on spectral energy distribution and angular distribution of protons and electrons, measurement of electric and magnetic field intensities (DC and AC) (improved equipment, similar to SPAZ-apparatus). <u>Agency's contribution:</u> measurement of spectral energy distribution and angular distribution of electrons and protons, with a high degree of spatiotemporal resolution.	a) MPS b) Pfozter, Keppler
21	T	IMS & GEOS follow-on program in 1975/76	Required are coordinated ground observations in relation to the dynamics of the magnetosphere, to be accomplished through an international team effort.	Photographic recording of auroral features, photometric analysis of auroral displays, VHF-backscatter associated with auroral phenomena, CNA observations with riometers, observations on whistlers and associated VLF-emission, geomagnetic field variations and micropulsations. <u>Recommendation:</u> network of 10 standard installations for gathering data (capable of recording events occurring with periodicities between 3 and 200 seconds), distributed throughout the auroral latitudes and with one located close to the geomagnetic equator.	a) MPS b) Pfozter

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
X-ray spectra as a function of time	a) Scintillation detector b) c)	a) b) c) d) Balloon ascensions in Kiruna, Sweden, possibly also in Iceland	As part of SPARMO project		a) Approx. 50 balloon ascensions
e: 15 keV-1 MeV p: 50 keV-10 MeV	a) b) c)	a) b) c) d) Launch from Kiruna (Sweden), Andenes (Norway), Iceland	E.g., as in SPAZ project, close to operation with Scandinavian efforts	a) See column 5	a) 10 rocket launches
		b) d) Ground Stations in Tromsö, Kevo, Sodankylä, Oulu, Nurmijärvi, Lindau, Tannus region of Germany, and others	Norway, Sweden, Finland, Germany Recommendations to IUCSTP	In collaboration with MPS & IGG	

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FIELD OF RESEARCH: ASTRONOMY/IONOSPHERE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
22	T	IMS/GEOS	Interaction between magnetosphere and ionosphere.	Establishment of a permanent <u>auroral observation station</u> , with closed-circuit TV, etc., at Abisko or Sodanklyä.	a) Haerendel, Neuss
23	T	IMS/GEOS program for 1975-77; project requires in intl. team effort	Structural features of auroral and polar cap phenomena, interactions between magnetosphere and ionosphere, dynamics of the ionosphere, struc-	European Incoherent Scatter Facility in the Auroral Zone, Feasibility Study, June 1971 (EISCAT). Measurements on concentration of electrons, temperature of electrons and ions, derivation of temperature of gases in the neutral state, electric field intensity, plasma drift, density of gases in the neutral state, composition of ion clouds, low energy electrons (in the 1-100 electron volt range).	a) MPIO & MPE b) Kohl & Haerendel
24	R S		Northern lights (aurorae): excitation mechanism and energy dissipation	Measurements of radiation emitted in the infrared and extreme ultraviolet spectral regions (variation thereof with altitude). (Additionally, measurement of particles associated with auroral phenomena). <u>Simultaneous</u> ground observations are required; in this case, interest is mainly directed to an experimental program involving high altitude research rockets and a sensor satellite in polar orbit.	a) IPAO b) Stätter
25	R	PEJ-2: follow-on and extension of PEJ-1 program of 1968	Electrojet phenomena in the polar regions: investigation of the structure of ionospheric flow patterns in the auroral zones, and evidence for the effect of current systems flowing in the magnetosphere.	Recordings of the intensity of geomagnetic field components as this varies with altitude; simultaneous measurements of electron density and intensity of electric fields within the ionosphere, as well as the attitude of the rocket. Determination of orientation of associated system of currents by means of a high-speed, automatic position plotting system: two magnetometer units and two scanning riometers.	a) IGMB b) Musmann
26	T		Interaction between magnetosphere and ionosphere. This effort is instrumental in deciding the validity of one or the other of two different conceptual models for the	Investigation of reverse electric currents associated with the polar electrojet, in middle latitudes of the ionosphere; measurements of the geomagnetic field will be taken during maxima of geomagnetic bay disturbances or substorms, simultaneously from instrumented high	a) IGG b) Siebert

T = ground observation; F = high altitude aircraft; R = high altitude research rocket; B = balloon; S = satellite; P = space sensor; RS = space station

[illegible]

FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
27	R	Continuation of 1970 program and of ESRO project S-87, 1971	<p>ionosphere: either reverse currents <u>do</u> exist in middle geomagnetic latitudes of the ionosphere, or else they <u>do not</u> exist.</p> <p>The ionospheric plasma: it is desired to obtain data related to plasma phenomena in the E- and F-layers of the ionosphere in order to supplement and enlarge upon data previously obtained by means of satellite measurements or rocket measurements taken at irregular intervals.</p>	<p>altitude research rockets and from ground stations.</p> <p><u>Agency's contribution:</u> measurements made at ground stations. <u>Simultaneous</u> measurements made from instrumented rockets are required, such as already discussed in proposal item No. 25.</p> <p>Recordings of variations in ion density with altitude, likewise of temperature and of drift current components perpendicular to the spin axis of the rocket. These measurements must be made with an angular resolution exceeding an accuracy of $\pm 5\%$, and with a discrimination of the height of the rocket which is no worse than the length of the flight path traveled by the rocket during one cycle of its spin.</p>	<p>a) PIH b) Schumann</p>
28	R	IMS/GEOS program, 1974-76 (ESRO project #R-428)	Interaction between magnetosphere and ionosphere. This program will help to decide on the validity of different theoretical models concerning the mechanisms for interaction	Investigations concerning the physics of auroral phenomena. Study of <u>electric fields</u> in the polar electrojet, in a direction <u>parallel</u> to that of the lines of force of the earth's magnetic field.	<p>a) MPE b) Haerendel, Paschmann</p>

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FIELD OF RESEARCH: ATMOSPHERE/IONOSPHERE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
	<p>a) Reverse-grid analyzer b) c)</p>	<p>a) Rocket trajectories to altitudes betw. 100 and 300 km b) c) Spin-stabilized d)</p>			
<p>E-field: voltage differential B: 100 V/m ⊥ B: 1 mV/m n_e: 10⁴ - 10⁶ cm³ Meas. of auroral particles consisting of protons and electrons having energies between 0.5 - 15 keV</p>	<p>a) 1. Radiation from Barium ions 2. Impedance probe 3. Magnetic spectrometer</p>	<p>a) 400-500 km b) 14 mins c) d) Launch site at Andoya, beginning in Mar/Apr 1972</p>	<p>Participation in evaluation of data from GEOS Low Energy Particle Experiment (GLEPCO) under Hultqvist</p>		<p>a) Dragon III booster 1 launch '72 1 launch '73 '74 Dual Hawk booster 2 launches 1974 5 launches in fall of 1975 & 76 b) 1972 c) until 1976</p>

(Concluded)

II. MAGNETOSPHERE

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Concentrated, closely coordinated efforts in conjunction with support of the International Magnetospheric Survey (IMS) are encouraged, to include ground observations, use of high altitude research rockets and use of a "small satellite for magnetospheric studies". Emphasis is placed upon program accomplishment in a time-frame coinciding with the GEOS and HELIOS mission profiles for 1974-1976.

FIELD OF RESEARCH: MAGNETOSPHERE

1	2	3	4	5	6	
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor	
29	R	IMS program 1975-77	Follow-on program to IMS satellites: assignment of high altitude research rocket projects during various phases of particular geomagnetic events (substorms).	Measurements of the following: 1. Steady-state electric field intensity, using diverse methods (barium clouds, ionospheric probes). 2. Varying electromagnetic field effects. 3. Flux density of magnetospheric particles and properties of the plasma. <u>Contribution by MPS:</u> Measurement of spectral energy distribution and angular distribution of electrons and protons, with a high degree of spatiotemporal resolution.	a) MPS b) Pfozter Keppler	/20
30	R S	Associate program to ESRO project R-215	Processes occurring in the earth's radiation belt, interaction between waves and particles. Simultaneous measurement of an "event" at as many points within the magnetosphere as is possible: entry of solar particles into the polar cap region of the magnetosphere (possible relationship between the force fields of interplanetary space and of the magnetosphere??), distribution of electrons at MEV energy levels in the radiation belt, relative concentration of helium atoms.	1. Measurements of electrons, protons and alpha-particles and their angular distribution in space, simultaneously throughout the northern and southern polar cap regions of the magnetosphere, as well as north and south of the neutral sheet within the magnetosphere "tail". 2. Measurements on electrons at MEV energy levels and their angular distribution within the radiation belt, simultaneously with measurements of fluctuations of electromagnetic field intensity. 3. Determination of the concentration of helium in the magnetosphere, particularly after magnetic storms have occurred.	a) IKKI b) Wibberenz	
31	S	ESRO IV (project #S-103)	Solar-terrestrial interrelationships, low energy level radiation (supports investigation of the ionosphere and solar particles).	Measurements of <u>protons</u> and <u>alpha-particles</u> in the solar stream of particles and in the radiation belt.	a) MPE b) Hovestadt	

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
E = balloon; S = satellite; P = space sensor; RS = space station

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
32	S	Associate program to IMS	Magnetospheric convection at the magnetopause: evidence supporting the existence of a sudden decrease in plasma density at high geomagnetic latitudes.	<ol style="list-style-type: none"> 1. Measurement of the static <u>electric field intensity</u>. 2. Measurement of the static geomagnetic field intensity. 3. Measurement of the <u>velocity of the convection currents of electrons and ions</u> in the thermal plasma region. 4. Measurement of flux density of particles with energy lying in the range between 10 eV and approximately 50 eV. 	a) APW b) Grabowski
33	S		Magnetospheric convection currents in the tail region: observations in the transitional region between the magnetopause and the neutral sheet.	Same experiments as contained in proposal item number 32.	a) APW b) Grabowski
34	S T	Associated also with HELIOS program	Observations of varying, low-frequency electromagnetic fields in the magnetosphere. Correlation between grd. observations & projects related to the solar wind. Effects of the magnetopause upon propagating wave systems.	Measurement of <u>time-varying, low-frequency electromagnetic fields</u> , covering all frequencies throughout the ELF and VLF regions. Resolution (of E-M waves) into <u>transverse and longitudinal components</u> (using combinations of dipole and helical antenna arrays), magnetometer (for extremely low frequencies). For measuring <u>background noise</u> , techniques employing tunable narrowband filters are contemplated (in addition to this, measurements also on spectral emission from streams of particles in the magnetopause). Simultaneous ground observations are required.	a) APW b) Grabowski
35	S	Associated with IMS, GEOS programs	Pending program, or possible substitution for the ESRO "Small Magnetospheric Satellite" program, in conjunction with GEOS		a) MPS b) Pfozter

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FIELD OF RESEARCH: MAGNETOSPHERE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
		<p>a) high eccentric orbit at lowest possible angle of incidence to the magnetopause</p> <p>a) highly eccentric orbit</p> <p>a) highly eccentric orbit crossing through the magnetosphere along a path approximately parallel to the magnetic lines of force.</p>			<p>a) measurement of particle flux density</p> <p>b) tracking of satellite in its orbit</p>

FIELD OF RESEARCH: MAGNETOSPHERE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
36	S	Associated with HELIOS IMS programs	Investigation of particles and fields within regions of the magnetosphere in close proximity to the earth.	Measurements on particles such as electrons, protons, alpha-particles and those of higher atomic number Z; measurements on the magnetic field and the plasma.	a) MPS b) Keppler
37	S	Associated with IMS/GEOS HELIOS programs	Investigation of drift and acceleration processes in the outer regions of the magnetosphere ($L \geq 3$)	1. High-resolution spatiotemporal measurements on pitch angle and energy spectra of low- and moderate-energy level charged particles 2. Measurements on the plasma. 3. Measurements on electric and magnetic field intensities.	a) MPS b) Keppler
38	S		Generation processes for and propagation of electromagnetic fields. Properties of the magnetospheric plasma, verification of existing theories.	1. Measurement of magnetic and electric field intensities, each in its three vector components, throughout a wide range of frequencies (DC through 20 kHz) 2. Measurement of density of electrons, of energy distribution and angular distribution in space of electrons and protons having energies between 1 to 200 keV and measurement of the omnidirectional plasma flow of particles having energies between 0.2 and 1 MeV. <u>Simultaneous ground observations are required.</u>	a) IGMB b) Musmann
39	S		Micrometeorites: determination of the part the Moon plays as a possible source for the influx of meteoritic matter in regions close to the Earth.	Results of chemical analyses of meteoritic dust from experiments similar to those used in the HELIOS A/B programs: measurements of micrometeorites, mass spectrometry	a) MPK b) Fechtig

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

FIELD OF RESEARCH: MAGNETOSPHERE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Electric and magnetic fields from DC thru 20 kHz frequencies n_e : electrons and protons: resolution of energy spectra in 1-200 keV region, and of spatial distribution. Also spatial flux distribution in energy region of 0.2-1 MeV Masses $>10^{-15}$ g, velocities from 2 to 100 km/s, chemical composition (for $M = 15-70^\circ$ angle of incidence)	a) 3-element Förster probe from 0 to 1 Hz, 3-element induction coil from 1 Hz - 1 kHz, 3-element induction coil from 0.5-20 kHz, attitude sensing system a) 2 analyzers for micro-meteorites b) equipment patterned after designs used in HELIOS program c) 10.4 kg/ 6.6 W/ ≤ 15 bps	a) Orbit similar to HELIOS or IMP a) polar, non-helio-synchronous orbit b) one year c)		a) electric field measurements from DC to 20 kHz, proton and electron analyzers, and omni-directional counters b)	

(Concluded)

III. SOLAR/INTERPLANETARY SPACE

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
40	B	Follow-on to Spectro-Stratoscope Project, Phase I	Solar atmosphere: definition of its structural features in space, and associated spectral characteristics	1. High-resolution <u>spectroscopy in the visible region of light, with angular definition of 0.4 minutes</u> (improved version of the "Spectro-Stratoscope I" balloon instrumentation). 2. Spatial and spectroscopic resolution of structural features, with definition of size and dimensions of the order of magnitude provide by scale division of 100 to 150 kilometers: incremental development of a larger, balloon-borne telescope (with an aperture of 80 centimeters).	a) FIF b) Kiepenheuer
41	B		Solar Physics	Measurement of the <u>polarization of radiation from solar flares</u> , caused by Thomson scattering, at wavelengths below 0.5 Å	a) AIT b) Trümper, Elwert
42	B		Inferences on theoretical models to explain flare phenomena, and on the question of whether or not albedo neutrons scattered upward out of the earth's atmosphere may possibly be considered as the origin of the radiation belt.	Observations of <u>solar neutrons</u> and of <u>albedo neutrons</u> to determine how they depend upon geomagnetic latitude and the solar (sunspot) cycle: measurements of particle flux density, energy spectra, and spatial distribution. Continuation of balloon flights conducted in 1971 by Rice University (Texas) at Fort Churchill, near Hudson Bay, Canada.	a) MPE b) Reppin
43	R	Follow-on to ESRO project # S-98	Solar Physics	<u>Spectral heliography at x-ray wavelengths</u> , by means of Fresnel zone plate equipment having a high ring density and use of a diffraction-grating monochromator provided with appropriate spectral filters.	a) AIT b) Trümper, Elwert
44	R	Participation in team effort supporting ESRO project as required	Study of the Sun: detailed analysis of the transitional region between the corona and the chromosphere.	Recordings of spectra, and spectroheliograms in the extreme ultraviolet region, with equipment having high-power resolution capability.	a) FIF b) Kiepenheuer
45	R S		Solar Physics	Measurement of the <u>polarization of radiation emitted by solar flares</u> through photo-electric processes associated with flare motion and reflection from the Sun's surface; region of investigation covers soft x-rays and ultraviolet emission	a) AIT b) Trümper

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FIELD OF RESEARCH: SOLAR/INTERPLANETARY SPACE (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
<p>Polarization of x-rays in the spectral region below wavelengths of 0.5 Å.</p> <p>Neutrons in the energy region from 70 to 300 MeV \pm 20% resolution field of view is 4π steradians, with solid-angular resolution of 5°</p>	<p>a) neutron telescope b) completed c) recording by optical means (12,000 photographs per flight)</p>	<p>a) ≥ 35 km alt. b) about 6 hrs c) d) balloon ascension in Fort Churchill Canada</p>	<p>APW</p>		<p>a) 1 balloon flight b) c)</p>

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FIELD OF RESEARCH: SOLAR/INTERPLANETARY SPACE (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
46	T R S	Associated with HELIOS A/B, IMS projects 1974-1977	Concentrated, closely coordinated efforts for grd. observations are encouraged, according to recommendations made by the IMS Study Group of IUCSTP	1. Observations of solar magnetic field intensity 2. Radio-astronomic observations 3. Observations on the interplanetary medium in the vicinity of the Earth's orbit	a) MPS b) Pfozter
47	R S T		Solar Physics. Analysis of phenomena occurring in local regions of the chromosphere and corona. Solar-terrestrial phenomena.	Solar observations in the <u>ultra-violet region</u> of the spectrum, with regard to temperature distribution and chemical composition: measurement of <u>intensity</u> of radiation, with special <u>emphasis on particular spectral lines</u> in the ultraviolet region, and of spatial distribution of the radiation. <u>Simultaneous</u> grd. observations of spectra in the visible region are required (to obtain evidence concerning localized structural features of the Sun's magnetic field). a) launching of research rockets b) satellite programs associated with other research tasks, for probing of the interplanetary plasma, and especially for observing the magnetic field associated with the solar wind.	a) APW b) Grabowski
48	S		Solar Physics. Acceleration mechanisms for the Sun's cosmic radiation during events involving solar flares and intertwining of plasma sheets (of particles); inferences concerning the depth of the layered structure of the Sun and the extent to which it penetrates throughout the solar atmosphere trapping and propagation mechanisms of the solar wind in the coronal region of the Sun.	Investigation of the chemical composition of the <u>cosmic radiation (solar wind) of the Sun</u> ; presence of ionic states of all atoms up to and including iron, with energies up to 1 MeV per atomic number N of the ion, will be determined (with special interest in He, C, O, Si and Fe) 1. Measurement of chemical composition of localized regions of solar flares. 2. Measurements on "intertwined" (plasma) particles originating from large, highly active regions of the Sun.	a) IKKI b) Wibberenz

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
			Should stimulate cooperative efforts	a) with research rocket experiments, possibly combined with airglow experiment b) grd. observations in visible region of the spectrum	
			Should stimulate as many as possible independent measuring techniques		

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
49	S	Problems concerning interplanetary dust, in particular as this relates to the zodiacal light.	Problems concerning interplanetary dust, in particular as this relates to the zodiacal light	Fundamental research and theoretical work are required in conjunction with experiments conducted by other agencies on studies concerning interplanetary dust (size of particles, their composition, distribution in space), using optical measurements (color, intensity, polarization).	a) EPB b) Giese
50	S	CNES or project of HELIOS-A3 program	Study of the interaction between solar winds and stellar winds.	Research on <u>interplanetary hydrogen</u> a) Detailed spectral analysis of hydrogen Lyman-alpha emission and radiation from helium (wide-angle photometry with a few degrees of resolving power) b) Comet surveillance and determination of the rate of dissipation of their gases.	a) MPE b) Haser
51	R		Planetary atmospheres, in this case, Jupiter	Sounding of Jupiter's atmosphere with a sensor in the far infrared region of the spectrum (determination of the mixing ratio of helium to hydrogen gases He/H ₂ , concentration of ammonia gas NH ₃ , temperature of the atmosphere above the cloud layers), using interferometric measuring techniques.	a) MIM b) Bolle
52	R S		Planetary atmospheres	Scattering of light through planetary atmospheres. This agency's contribution consists of fundamental research and theoretical work.	a) EPB b) Giese

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Ly- α 1216 Å and HeI 584 Å, bandwidth of 1.01 Å; 3970 Å (OH-emission from comets), bandwidth of ± 20 Å; polarization	a) 2 photometers 1 Ly- α polarization analyzer b) c) 10 kg/< 10 W/40 bps and also 10 analog measurements per minute	EUROPA II (including DIAMANT D/C) a) outside of earth's radiation belt, with apogee of about 10^5 km and 5° inclination to ecliptic plane b) c) spin-stabilized d) launch in 1973	Fundamental research & theoretical contributions to experiments by others Prof. Blamont (CNRS)	a)	a) 1 satellite b) 1972 c) four years

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IV. ASTROPHYSICS/ASTRONOMY

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
53	B	Follow-on to THISBE I program	Contributes to understanding the origin and formation of galaxies, the structure of galaxies, absorption by interstellar matter, make-up and composition of the Milky Way	<ol style="list-style-type: none"> 1. Wide-angle photometry of the Milky Way in spectral regions from the near ultraviolet through the near infrared. 2. Photometry of the zodiacal light from the near ultraviolet through the near infrared. 3. Investigation of the luminosity of the night sky in the infrared region around 2.4 μ. 4. Extension of measurements in the ultraviolet through 2100 Å 	a) MPA b) Elsässer, Lemke
54	B	THISBE II	As in Proposed item No. 58	Spectroscopic and photometric investigations of specific objects in the sky (stars, galaxies, etc.) from the middle ultraviolet through the far infrared spectral regions. Feasibility study in 1971 on design concept for a highly stabilized balloon-borne telescope.	a) MPA b) Elsässer, Lemke
55	R	ESRO project # R-434	Structure of the Milky Way, zodiacal light	Wide-angle photometry of the Milky Way and region of the zodiacal light at 2200, 5000, 9000 Å and at 3 microns.	a) MPA b) Elsässer, Lemke
56	R S		Distribution of interstellar hydrogen throughout the solar system.	Measurement of Lyman-alpha radiation scattered in the region around the Sun: <ol style="list-style-type: none"> 1. During the 1973/4 period of minimum solar activity, when the density of hydrogen in the heliosphere rises and as it expands in a direction towards approaching clouds of hydrogen in the interplanetary medium, observations will be made using a narrow-prism ultraviolet spectrometer. The temperature may be derived directly from the data thus obtained on the relative intensities of the spectral lines studied in this series of observations. 2. Measurements will be made on two separate sectors of the radiation-scattering region around the Sun, in order to be able to differentiate between slow- and fast-moving hydrogen atoms. 	a) AEB b) Grewing

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7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
	a) balloon-borne telescope b) c)	a) H ₂ >42 km alt. b) c) balloon-borne telescope, stabilized to within 1/2°, and automatically oriented toward object being observed d)			
	a) balloon-borne telescope b) being designed c)				
	a) b) being designed	a) b) c) d) launch in April 1973			
	a) 1. narrow-prism UV spectrometer 2. UV spectrometer with H- and D- element filters	a) b) c) d) launch in 1973/74			Research rocket experiments in the 1973/74 time frame

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1	2	3	4	5	6	
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor	
57	T F R		Infrared Astronomy Determination of temperatures of celestial objects, problems concerning the evolution of stars, the nature and origin of the background cosmic radiation.	Spectrometry of galactic and extra-galactic sources of radiation in the infrared and sub-millimeter regions; measurement of background cosmic radiation. <u>Recommendation</u> for program implementation in several phases: 1. Additional measurements at high altitude observatories 2. Use of high altitude research aircraft (i.e., in collaboration with French research agencies) 3. High altitude research rockets 4. Satellites	a) AEB b) Grewing	/38
58	R S		Interstellar medium. Problems concerning its composition and related ionization processes	Measurement of absorption lines in ultraviolet spectral regions by interstellar matter, using high-resolution spectrometry in various directions of space and stars at various distances as sources for this investigation	a) AEB b) Grewing	
59	S	Associated with HELIOS program	Cosmic radiation during HELIOS mission	Correlated measurements of cosmic radiation in close proximity to the earth. <u>Recommendation</u> for a "piggyback" type of satellite, as in the ORS III program	a) IKKI b) Wibberenz Beuermann Hasler	
60	R		X-ray sources	Rocket observations of galactic and extra-galactic sources of x-rays with energies less than 3 keV.	a) AIT b) Trümper	
61	S	IMP-H IMP-J projects	Low-energy cosmic radiation.	Investigation of <u>low-energy</u> cosmic radiation, measurement of particle composition, flux density, energy spectra (double peak analysis) and spatial distribution.	a) MPE b) Hovestadt	/40
62	S	IMP-K/K'	Low-energy cosmic radiation	Follow-on to IMP-H & -J projects	a) MPE b) Hovestadt	

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Resonance lines in the UV spectral region between 1000-2000 Å Resolution:	a) High resolution UV spectrograph with image converter				/39
X-rays: <3 keV	a) proportional counter, with large area anode, used to reproduce events occurring along one axis b) c)				
Nuclear charge number (Z) for $1 \leq Z \leq 29$; energy levels: for protons - 0.5-2 MeV, up to iron - 0.06-35 MeV/N, ap. angle 42° meas. of sp. distr. in 8 energy bands	a) shallow proportional counter tube with semicond. counter to measure ΔE-E, use of anti-coincidence shield b) completed c) directivity of counter is ⊥ to spin axis	a) 39/32 earth radii inclination of 28.5° b) c) spin of 46 rpm (as in IMP-H); 24 rpm (as in IMP-J) rotational axis directed to pole of the ecliptic d) launches, IMP-H: 1972 IMP-J: 1973	Experiment jointly conducted with Univ. of Maryland	a) Meas. of electr. and magn. fields, higher energy particles and plasma. No. of experiments: IMP-H: 13 IMP-J: 12	a) several satellites b) current program c) follow-on to IMP-K/K' d)
Similar to IMP-H & -J	a) Similar to IMP-H & -J b) c)	a) b) c) d) twin satellites launch in 1975/76		a) b)	a) b) current program c) d)

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
63	B		High-energy cosmic radiation	Measurement of the flux density and energy spectra of high-energy electrons, associated transition radiation.	a) MPE b) Hovestadt
64	B		Investigation of cosmic radiation, to obtain evidence on its origin and formation. Hopefully, and extension of available knowledge will be obtained by investigating particles with higher nuclear charge Z in the region of higher energies and lower particle flux density.	Exploration of the celestial sphere to obtain data on structural features in space of the drift and circulation of particles; investigation of particle composition according to energy of the various constituents.	a) MPE b) Schmidt, W.
65	S	HEAO-A		By means of the satellite experiment, scanning for sources of cosmic radiation may be accomplished in two opposite directions, allowing more precise determination of the energy of incident particles. MPE staff members will participate on the satellite project and develop a working model.	
66	B		X-ray Astronomy	Investigation of selected, known sources of <u>x-radiation in the energy region between 30 to 100 keV</u> , over a period of several years in order to determine the extent of long-term and short-term temporal variations of the spectra. Continuation of measurements begun in 1971 on the Crab Nebula and Cygnus X1.	a) MPE b) Schönfelder
67	B		Low-energy gamma ray astronomy. a) Search for extra-terrestrial point sources of gamma radiation in the MeV energy range; inferences concerning their evolutionary processes, in conjunction with further considerations on the x-ray	a) Search for extra-terrestrial point sources for <u>gamma-rays in the MeV energy range</u> , and determination of their energy spectra. b) Determination of the <u>diffuse spectrum for gamma-rays</u> . c) Measurement of energy distribution and spatial distribution of <u>gamma-energy sources in the atmosphere</u> . <u>Phase 1. (1972/73):</u> trial demonstration of this measuring technique with effective counting.	a) MPE b) Schönfelder

ground observation; F = high altitude aircraft; R = high altitude research rocket; balloon; S = satellite; P = space sensor; RS = space station

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Energy region: > 100 GeV Fluxes larger than 10^{-4} part./ m^2 sec sr; energy region: $10^{10} - 10^{14}$ eV (protons); about ± 3 chgs for balloon & about $\pm 1/2$ chg for satellite experiments in resolving Z of particle; field of view: about $\pm 45^\circ$ or $1 m^2$ sterad	a) b) still to be developed over a period of two years a) ionization spectrometer (lead target for one flight, another w. carbon target) b) completed c) a) ionization spectrometer (tungsten target) b) dev. being conducted at Goddard c) Measurements made along direction \perp to spin axis	a) alt. below atmos. press. of $5 g/cm^2$ b) c) measurements taken towards zenith a) ≥ 35 km ($< 6 g/cm^2$) b) about 20 hour balloon flight c) d) 2 balloon flights in Texas in 1972 a) circular orbit 370 km below radiation belt; with inclination of about 28° b) c) spin-stabilized at 1-10 rpm, oriented towards the Sun d) launch date in 1975/76	Joint effort with GSFC (Principal Investigator Ormes) and 3 universities in USA		a) b)
X-rays in 30-100 keV energy region; aper. angle - $3^\circ \times 3^\circ$; comparison of rad. level of sources w. background rad. meas. in opp. dir. from source; av. expected rate of events is about 20/sec	a) X radiation telescope (scintillation counter with passive lead collimator and lead shielding for anti-coincidence). b) completed c) $1 \leq 2000$ bps	a) ≥ 35 km alt. b) 6-8 hrs/flight c) pointing accuracy: 1° (for stabilized magnetometer); directed alternately every $1/2$ hr. from source to background level of sky in opp. dir. d) launch site in Palestine, Texas			a) 2 launches per year b) 1971 c) 1975
Energy region of 1-10 MeV; resolution of energy levels to about 30-40%; probability of detection is about 1%; separation of atm. background rad. from scattered primary rad. thru obs. at	a) gamma radiation telescope (two plastic scintillation detectors mounted reciprocally 1 meter opposite one another, measurement of pulse height and determination of transit time of event, anti-coincidence screening with plastic medium). b)	a) alt $< 3 g/cm^2$ to $6 g/cm^2$ b) c) <u>Phase 1</u> : meas. made in direction of zenith <u>Phase 2</u> : steerable with directional stability d) launch site in Palestine, Tex			a) 1-2 launches per year b) 1972 Phase 2: 1973 c)

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
68	S	HEAO-B	<p>spectra. b) Determination of diffuse gamma-ray spectra; comments on Vette's theoretical speculations to explain the gamma-ray excess in the 1 - 6 MeV region.</p> <p>Gamma-ray astronomy study of the structure of the universe, production of electromagnetic radiation, energy density in space.</p>	<p>area of 200 cm² and measurements of a) and b) above, for events occurring at the rate of about one per second. Phase 2. (after 1973): Increase in effective counting area to about 1 m² and measurement of a) above with space stabilization of instrumentation required.</p> <p>Investigation of gamma-radiation at energy levels from 30 MeV through 100 GeV, search for interesting celestial objects principally located in the galactic plane (correlation between x-ray and gamma-ray studies), investigation of time-varying phenomena (for example: pulsars, SN-bursts, flares).</p>	<p>a) MPE b) Sommer</p>
69	S	TD-1, ESRO project S-133	Gamma-ray astronomy identification of gamma-radiation	Identification of <u>gamma-radiation</u> , with regard to direction of its origin; no resolution of its energy spectra	<p>a) MPE b) Pinkau, Voges</p>
70	S	COS-B, ESRO program	gamma-ray astronomy	Investigation of the <u>spectrum of background gamma-radiation and strong sources of γ-rays</u>	<p>a) MPE b) Pinkau, Mayer-Hassel-Wander</p>

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
var. altitudes in <u>Phase 1</u> of program	c) about 40 bps data rate for Phase 1				
Energy levels from 0.03 to 100 GeV with resolution of about 4% (in 0.07-100 GeV region; timing accuracy no greater than 1 millisecond spatial resolution about 0.5° (depending upon energy of incident rad.; steerable aper. angle experiment conducted \perp to spin axis	a) Gamma-ray telescope with wire spark chamber (eff. area of about 5000 cm ²) meas. of trans. time determ. of energy level of rad. in CsJ(Tl) crystal, with anticoincidence b) MPE currently working on its contr. to developing scheme for anti-coincidence c) weight of total payload is 9:500 kg	TITAN IIID satellite a) 370 km orbit with 28.5° inclination b) 2 yrs duration c) spin-stabilized at 0.1 rpm, spin axis oriented towards Sun, pointing accuracy $\pm 1^\circ$, off-set pointing from Sun of $\pm 40^\circ$, time to acquire pointing direction is about 45 mins.	Co-principal investigators: Hofstadter Fichtel in collab. w. Stanford U., GSFC, Grumman Aerospace Corp., MPE	a) The payload contains addtl. experiments for meas. of x-rays, radiation from highly energetic particles low-energy gamma-radiation	a) HEAO-program b) c) d)
70-300 MeV	a) Spark chamber (w. eff. area of approx. 200 cm ²) b) Completed c) Weight of total payload is 445 kg, that of scientific payload subsystems is 120 kg.	THOR-DELTA-Satellite a) 550 km orbit with 97.5° inclination b) c) Stabilized in all 3 axes, one of which points to the Sun d) Launch in Spring of 1972	Italy France Germany	a) 6 addtl. experiments for study of solar-terrestrial phenomena	
30 MeV - 10 GeV resolution of energy levels is about 50%; field of view is $\sim 45^\circ$ (FWHM) spatial resolution between 2° and 6°	a) Spark chamber (with eff. area of approx. 750 cm ²), anticoincidence meas. technique, trigger-telescope, energy calorimeter b) dev. now under way c) 100 kg	EUROPA-II satellite a) 10 ⁵ /350 km orbit inclination b) c) Spin-stabilized at 10 rpm, with offset pointing of spin axis \rightarrow	d) launch in mid 1974		

FIELD OF RESEARCH: ASTROPHYSICS/ASTRONOMY (Continued)

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
71	S		Gamma-ray astronomy. Discovery and investigation of gamma-ray sources.	Discovery of <u>sources</u> , meas. of their total energy, investigation of <u>pulsations</u> and other <u>time-varying phenomena</u> , possibly in conjunction with x-ray studies for identification of and derivation of a direct correlation with γ -ray studies.	a) MPE b) Sommer
72	B		Gamma-ray astronomy	Development and implementation of research balloon experiments throughout the lower <u>energy region between 5 and 50 MeV</u>	a) MPE b) Mayer-Hassel-Wander

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FIELD OF RESEARCH: ASTROPHYSICS/ASTRONOMY (Continued)

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
10-100 MeV, expectation probability (of event) is 0.1; aper. angle about $\pm 15^\circ$, spatial resolution between 2° & 8° (depending on energy level)	a) Spark chamber (eff. area 1000 cm^2) anti-coincidence, trigger telescope b) Planned c)	a) alt. $\leq 3 \text{ g/cm}^2$ b) about 8 hrs. c) flywheel stabilization and steering drive mechanism, attitude sensing system using the geomagnetic field for orientation, also included is provision for taking aerial photographs of the earth's surface			a) b) current c) program d)
5 - 50 MeV; aper. angle between 1° and 6°	a) Dev. of active collimation technique for small aperture angles	a) b) c) accuracy of 1°			

(Concluded)

V. PROPOSED EXPERIMENTS FOR THE ECLIPSE
1973 PROGRAM

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
73	R T	ECLIPSE 1973	Solar Physics. Establishment of theoretical models for the transition- al region between the chromosphere and the corona, and for the lower corona.	Determination of edge-brightening variations for several EUV-emission lines: 977A - CIII 8.0×10^4 K 1032A - OVI 3.2×10^5 K 625A - MgX 1.3×10^6 K 499A - SiXII 2.5×10^6 K Edge resolution about 2' (sol. angle) Height resolution about 1". <u>Simultaneous</u> ground observations of the sun in H-alpha light are required.	a) APW b) Schweizer, Schmidtke Acton (Lockheed Palo Alto Res. Lab., USA)
74	R	ECLIPSE 1973	Solar-terrestrial effects: interpretation of processes occurring in the atmosphere (photo-disassociation, ionization, etc.)	Measurements of the Airglow. During daylight hours, the primary emission lines below 1400 A are: 1356A, 1304A for OI 1216A for H-I α 834A for OII 584A for HeI 304A for HeII whereas at night only the 1356A and 1304 lines may be measured. The solar eclipse will permit determination of as yet unknown reaction coefficients for specific emissions.	a) APW b) Fischer, Schmidtke
75	R T	ECLIPSE 1973	Solar-terrestrial effects.	Determination of absolute solar photon flux density during the eclipse, throughout the 30 to 107 and 15 to 59 nanometer wavelength regions. (Supplementary measurement of the temperature of the atmospheric gases, both in the ionized and in the neutral states, and the concentrations of N ₂ , O ₂ and O). <u>Simultaneous</u> ground observations of the sun are required in both visible and H-alpha light.	a) APW b) Schmidtke, Schweizer, Fischer, Knothe
76	R T	ECLIPSE 1973	Dynamics of the ionosphere in equatorial regions, study of its thermal equilibrium, relaxation time, rate of cooling and energy transfer mechanisms.	Measurements of temperature of electrons, of photo-electrons, and, ultimately, of ionospheric currents. (Additional measurements on electron density). <u>Simultaneous</u> ground observations with ionosondes are required.	a) APW b) Spenner Dumbs
77	R	ECLIPSE	Dynamics of the ionosphere in equatorial regions, emphasis on the equatorial. Anomaly and ionospheric transport phenomena.	Experiment to be conducted as part of an integrated payload per proposed item number (blank). Measurement of electron density in the ionosphere. (Additional measurements on intensity of the geomagnetic field will be made). <u>Simultaneous</u> ground observations with ionosondes are required.	a) APW b) Domorazek, Kist, Neske

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
EUV: 499, 625, 977, 1032 A; aper. angle approx 2' (solid); alt. resolution of the limb of the sun about 1".	a) EUV telescope b) time req. for assembly is 5 months c) 4.5 kg/4.4 W max/6.7 cubic decimeters	a) >200 km alt. b) 4 min above 150 km alt. c) directivity towards sun $<2-3^\circ$, w. deviation $<3''/\text{min}$ rotation about pointing axis $<0.5^\circ/\text{min}$. d) recovery by parachute		a) - b) ground observation of the sun in H- α light	a) 1 research rocket b) c) 30 June 73
EUV: 304, 584, 834, 1216, 1304, 1356 A. Measurements made perpendicular to booster vehicle axis	a) EUV detector b) time req. for assembly is 1 year c) 2-3 kg/20 W/less than 3.7 cu. decimeters/	a) 220 km alt. b) 4 min above 150 km alt. c) spin-stabilized at 2-4 rps d) launch countdown takes 4 min		a) - b) -	a) 2 research rockets b) c) d) 30 June 73 launch from site within $+20^\circ$ lat. from geomag. equat.
Photon flux in spectral regions of 300 - 1070 A & 150 - 590 A	A) EUV detector b) time req. for dev. is 10 months c) 7.5 kg/18 W/9.2 cu. decim./	a) >190 km alt. b) c) solar orientation, accuracy $\pm 2^\circ$, deviation $<0.5^\circ/\text{min}$ rotation about pointing axis $<5^\circ/\text{minute}$ d) launch countdown takes 5 min		a) measurement of temperature of ionized & neutral components of solar atmosphere, conc. of $\text{N}_2, \text{O}_2, \text{O}$. b) heliograph in vis. & H- α region from ground stations	a) 1-2 res. rockets b) c) d) 30 June 73 launch sites as above
Electron temperatures	a) 2 detectors b) completion by end of 1972 c) 2.5 kg/7 W/3.3 cu. decim./	a) 220-300 km alt. b) c) spin-stabilized d) launch countdown takes 45 min		a) meas. of density of electrons b) ionosonde	a) no more than 4 res. rockets b) c) d) 30 June 73 launch sites as above
Electron density	a) impedance probe b) 6 mos. for assembly c) 1 kg/4.5 W / 1.1 dm ³ /	a) b) 2 min above 80 km c) no requirements d) launch countdown of 45-90 min		a) magnetic field meas. b) ionosonde	a) 4 res. rockets b) c) d) 30 June 73 Launch sites as above

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
78	R T	ECLIPSE 1973	Dynamics of the ionosphere in equatorial regions.	Determination of the steady-state electric field intensity by means of appropriate sounding instruments. (Additional measurements on ionospheric current flow patterns, geomagnetic field intensity). <u>Simultaneous ground observations with ionosondes are required.</u>	a) APW b) Unger, Grabowski
79	R T	ECLIPSE 1973	Study of rapidly occurring events in the ionosphere, related to processes which control the composition of the ionosphere (photo-ionization, disassociation of electrons from negative ions, photo-dissociation of clustered water ions), as well as their indirect effects through change in concentration of component parts of the ionosphere such as O , O_3 , $O_2(^1Vg)$, etc.	Mass-spectrometric measurement of the positive and negative ionic constituents of the D- and lower E-layers (in addition to this: measurement of the density of electrons and positive ions, Lyman-alpha spectrum studies, make-up of the neutral constituents of the ionosphere). <u>Simultaneous ground observations with ionosondes are required.</u>	a) MPK b) Arnold, Krankowsky
80	R T	ECLIPSE 1973	Atmospheric Physics. Study of temporal variations during the solar eclipse of the concentrations of atomic oxygen and ozone in the D-layer under the constraints of photochemical reactions which take place rapidly.	Measurements of composition, temperature and density of the neutral atmosphere at altitudes between 75 and 200, by means of a mass spectrometer utilizing a helium-cooled ion source. (In addition to this: Measurements of electron density and temperature, ion density, airglow measurements on O , $O_2(^1\Delta)$ and OH emissions, measurements on absorption by O_2 and O_3 of solar ultra-violet radiation, intensity of Lyman-alpha radiation. Composition of positive and negative ions). <u>Simultaneous recordings of ionograms are required.</u>	a) PIB b) von Zahn, Grossmann
81	R	ECLIPSE 1973	Solar Physics. Study of the temperature and density profile in the transitional region between the chromosphere and the corona.	Measurement as a function of time of the solar spectral lines in the extreme ultra-violet, using a high-resolution, grazing-incidence spectrograph.	a) AIT b) Bräuninger, Krämer, Trümper, Elwert

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
(Steady-state) electric field	a) probe for meas. of electric field intens. (2 boom prs) b) assy. in 6-12 mos c) 6-21 kg/2 W/ 1.5 dm ³ + 4 booms ea. 3-5 meters long/	a) >250 km alt. b) - c) spin-stabilized at 1 rps d) launch countdown of 45-90 min		a) turb. of ionic currents geomag field b) ion probe	a) 4 res. rockets b) c) d) 30 June 73 launch sites as above
Field of view to spin axis	a) mass spectrometer b) assy. in 10 mos. c) 10 kg/ 35 W/ 30 cu. decim./ 60 liters of liquid helium required at launch site	a) 90-100 km alt. b) non-critical c) spin-stabilized d) launch countdown: 1. 24 hr before or after totality 2. 5-15 min before start of totality 3. during totality		a) electron density; pos. ion density; Ly - α experiment; composition of neutral atmosphere; b) ionosphere	a) 3 res. rockets b) c) d) 30 June 73
Downward field of view	a) mass spectrometer (cryosonde) b) 10 mos for assy. c) 80 kg/ 42 W + other special needs/ 110 dm ³ / 24 kbps 150 liters of liquid helium or nitrogen needed at launch site	a) 140-300 km alt b) no requirements c) stabilization of two axes or spin-stabilized d) launch countdown: 1. 60 min before start of eclipse 2. 10 min before totality 3. at end of totality of eclipse		a) electron density & temperature, airglow, solar UV, Ly- α emission b) Ionograms, composition of pos. & neg. ions	a) 3 research rockets b) c) d) 30 June 73
EUV spectral lines	a) EUV spectrograph b) 12 mos. for assy. c) 25 kg/3.6 W(+ peak load)/ 32 dm ³ dry, gaseous nitrogen required at launch site	a) 200-250 km alt. b) 50 sec above 200 km alt. c) stabilization of two axes d) special launch requirements	APW proposal item # 1	a) - b) communication link to nearest solar observatory is required	a) 1 research rocket b) c) d) 30 June 73

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82	T	ECLIPSE 1973	Physics of the ionosphere. Study of the mechanism for absorption of radio waves in the D-layer.	A ₁ radio wave absorption. This experiment should yield data on changes occurring during solar eclipses of the overall concentration of electrons in the D-layer. These measurements, in conjunction with those obtained from high altitude research rockets, will permit a way of calibrating the A ₁ technique.	a) MPW b) Borchers, Rose, Weber, Widdel
83	T	ECLIPSE 1973	Physics of the ionosphere. Supports the calibration of measurements taken in rocket experiments.	Transportable ionosonde equipment. Continual coverage of changes in concentration of electrons in the E- and F-layers during the solar eclipse.	a) MPW b) Borchers, Rose, Weber, Widdel
84	R	ECLIPSE 1973	Physics of the ionosphere. Study of time-varying conditions during the solar eclipse.	SKUA II Payload a) Measurement of the concentration profile for electrons and charged particle up to altitudes of 100 kilometers; b) Measurement of the density of neutral gases and their turbulent flow in altitudes between 95 and 85 km (or lower); c) Measurement of the concentration of atomic oxygen. <u>Simultaneous</u> measurement of radio wave absorption with the use of ionosondes is required.	a) MPW b) Borchers, Rose, Weber, Widdel
85	R	ECLIPSE 1973	Physics of the ionosphere. Study of the time-varying changes in ionic composition between altitudes of 85 and 40 km during solar eclipse.	Measurement of the mobility and the concentration of charged particles below 80 km altitude (positive and negative ions and electrons) by means of a parachute-borne probe descending through the ionosphere (additional instrumentation; mass spectrometer, ionosonde for measuring the virtual radio height of the ionosphere, measurement of concentration of atomic oxygen).	a) MPW b) Borchers, Rose, Weber, Widdel

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
1-20 MHz, 50 Hz pulse repetition rate	a) Ionosonde b) c) /25 kW/ aa) modified Langmuir probe ab) reflective cloud composed of half-wavelength dipole strips made out of aluminum ac) O-probe using techniques developed by Henderson & Schiff	b) d) 4.5-ton van 10.5 ft. long, 2.5 ft. wide; 2.8-3.0 meters high; trailer w. 6kW power unit. antenna transporter with mobile ionosonde unit (see below). b) d) 15-ton van: 10.5 m long, 2.5 m wide, 2.8-3 meters high; semi-trailer for 3 antenna towers, trailer for power unit. a) alt.: 100 km b) c) no requirements d) 1-2 launches during totality, spread at intervals during the event; ground radar needed for tracking purposes		a) b) SKUA-II payload; ionosonde a) b) SKUA-II payload A ₁ radio wave absorption measurements	a) b) c) d) 30 June 73 a) b) c) d) 30 June 73
Positive & negative ions	a) ion counter (used as probe during parachute descent), w. telemetering, virtual radio height recorder, O-probe. b) nearly completed, as in ESRO project C33 c) <12 kg / diameter of instrumentation rocket exceeds 20 cm	a) 80-85 km alt. b) from 80 km down to 40 km c)		a) b) A ₁ radio wave absorption measurements, ionosonde.	a) 8-15 SKUA-II rockets b) c) d) 30 June 73 a) 3 res. rockets b) c) d) 30 June 73

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Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
86	R	ECLIPSE 1973	Physics of the ionosphere. Study of time-varying conditions of the ionosphere during the solar eclipse.	Measurement at altitudes above 150 km of the energy spectra of primary and secondary electrons having energies between 20 and 1500 eV (additional instrumentation: reverse-grid analyser designed by APW, magnetometer). <u>Simultaneous</u> recordings of ionograms are required.	a) MPIO b) Schlegel
87	T	ECLIPSE 1973	Still to be defined.	Not yet defined. Of importance is the possibility to make observations in the region about the central axis of the sun, at locations where there is little chance that any scientific investigation would be interrupted by the appearance of cloud formations in the sky.	a) Dept. of Meteorology of the Free University of Berlin b) Feussner
88	T	ECLIPSE 1973	Physics of the ionosphere. Study of the accumulation and dissipation rates of electrons in the ionosphere, also the presence of gravity waves in the atmosphere during the solar eclipse.	Observation of the total electronic content (TEC) of the ionosphere, using a radio beacon generated by a geo-stationary satellite. <u>Simultaneous</u> recordings of ionograms are required.	a) MPIO b) Schödel
89	R	ECLIPSE 1973	Physics of the ionosphere. Observation of the relative rise in intensity of OH- emission, compared with that of (OI) ₃₂ , shortly after sunset and just before sunrise.	Measurement of the variation with altitude of the OH- and (OI) ₃₂ emissions at 8360 Å and 5577 Å, respectively, at altitudes between 60 and 110 km. <u>Simultaneous</u> recordings of ionograms are required.	a) MIM b) Bolle, Bangert, Krieg, Scheidle

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
e: 20-1500eV Azimuthal ang. aper. of 45° above 150 km	a) electronic analyzer b) 6 mos. for assy. c) 1.8 kg / 2.5 W / 1.3 dm ³ / IRIG ≥ 17 (refers to <u>Inter-Range Instrumentation Group</u> standard that applies here)	a) 200-400 km alt b) - c) spin-stabilized d) one hour before and one hour after the eclipse and during totality		a) reverse-grid analyzer (APW), magnetometer b) ionograms	a) 3 res. rockets b) c) d) 30 June 1973
136 MHz	a) equip. suitable for installation in 19" rack space, crossed Yagi-antennas 3-6 observation sites separated by distances of 50 to 100 km b) operational status c) 200-watt, 220 V AC power source required			b) ionograms	
8360 and 5577 A directed towards zenith	a) 2 riometers 2 electronic units b) completed in 9 mos. c) 12 kg/40 W / 22 cu. decim./	a) 110-120 km alt. b) about 2 min above 60 km alt. c) spin-stabilized or two axes stabilized, trajectory perpendicular to the path of the moon's shadow d) launch countdown: (sequentially) 1. 1-3 hours before totality 2. Apogee of second launch should occur between 1.5 and 2.0 minutes after start of totality		a) magnetometer b) ionosonde	a) 2-3 res. rockets b) c) d) 30 June 73

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
 B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
		3. possibly a third launch occurring betw. 8 and 30 minutes after the second launch.			

VI. BIOPHYSICS/BIOLOGY*

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* Translator's note: Apparently this section was revised (see last section).

FIELD OF RESEARCH: BIOPHYSICS/BIOLOGY

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
B1	B		Genetic alterations to biological systems in the space environment. Significance: Problems concerning the contamination of other planets, sterilization of spacecraft, biological effects of radiation.	Investigation of the effect of space environmental factors (vacuum, cosmic radiation, solar radiation in the visible region, temperature conditions) upon biologic polymers and microorganisms. Subjects of research: Enzymes, nucleic acids, bacteriophages, bacteria.	a) ABR + MPB b) Bucker, Horneck Dose
B2	B R RS		Genetic alterations to biological systems in the space environment. Significance: Appraisal of hazards to human life during spaceflight and flying at supersonic speeds (SST).	BIOSTACK, investigation of the effects of heavy primary particles in cosmic radiation upon biological subjects. Subjects of research: Bacteriophages, bacterial spores, plant seeds, nematode (Ascarid) worm eggs.	a) ABR + MPB + ISM + ISIM (+KIFKS) b) Bucker, Horneck Reinholz Scheuermann Rüther
B3	T B		Genetic alterations to biological systems in the space environment. Significance: Appraisal of hazards to human life during spaceflight and flying at supersonic speeds (SST).	Investigation of the biological effects of heavy primary particles in cosmic radiation upon eggs of ocean crustaceans. Phase 1: Radiation with heavy ions from a particle accelerator Phase 2: Radiation with heavy primary particles in cosmic rays during a balloon-borne experiment.	a) NUCMED + IKKI b) Graul, Allkofer, Rüther, Heinrich
B4	R RS		Genetic alterations to and metabolic changes in the physiology of biological systems under spaceflight conditions. Significance: effect upon metabolism of launch phase and spaceflight conditions.	"Lucifer" project, investigation of the manner in which cellular metabolism is affected by conditions in the space environment. Subject of research: luminous bacteria.	a) ABR b) Bucker, Horneck
B5	RS		Genetic alterations to and metabolic changes in the physiology of biological systems under spaceflight conditions. Significance: Influence of gravity on the biologic development of research subjects.	Long-term influence of weightlessness under orbital conditions upon the biological development of several descendant generations of research subjects. Subject of research: Drosophila flies.	a) IBSH b) Künkel

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B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
<p>Phase 1 radiation with 10.2 MeV/N, Z ≤ 6</p> <p>Phase 2 radiation with ≤ 200 MeV/N, Z ≤ 6</p>	<p>a) BIOSTACK</p> <p>b) BIOSTACK (area of 1 m²) multilayer detector</p> <p>a) measurements on bacterial luminescence</p>	<p>Phase 2</p> <p>a) alt. ≤ 10g/cm² b) c) d) launch from Kiruna, Sweden, recovery efforts are required</p>	<p>1. part. accelerator located in the USA</p> <p>2. Balloon Flight Team of the IKKI</p>		<p>Phase 2 simultaneous launch of 3 balloons</p>

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FIELD OF RESEARCH: BIOPHYSICS/BIOLOGY (Continued)

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
B6	RS		Genetic alterations to and metabolic changes in the physiology of biological systems under space-flight conditions. Significance: Influence of weightlessness on the hormone balance of astronauts.	Influence upon activity of the cortical region of the adrenal glands during long periods of weightlessness in the space environment, possibly in conjunction with exposure to radiation. Subject of research: rats.	a) RIF b) Flemming
B7	RS		Genetic alterations to and metabolic changes in the physiology of biological systems under space-flight conditions. Significance: genetic alterations to astronauts during long-period journeys through the space environment.	Influence of both weightlessness and exposure to radiation upon oogenesis and spermatogenesis in mammals (point mutations and chromosomal abnormalities) Subjects of research: Chinese hamsters, mice.	a) IHF b) Degenhardt
B8	R S RS		Genetic alterations to and metabolic changes in the physiology of biological systems under space-flight conditions.	Effects of space environmental factors upon the metabolism of biological subjects. Subject of research: leeches	a) FEBF b) Lotz
B9	R RS		Presence of sub-biological molecules in the space environment. Significance: Origin of life, environmental research (contamination of the orbital path, environmental research).	Search for organic molecules in the flightpaths of spacecraft: a) free, subpolymeric organic molecules. b) polymeric, organic molecules associated with dust particles and micrometeorites.	a) MPB + ABR b) Dose Bücker

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

FIELD OF RESEARCH: BIOPHYSICS/BIOLOGY (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
	a) automatic biosonde				

VII. PROJECT HELIOS A/B

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1	2	3	4	5	6	
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor	
1	P	HELIOS A/B, in collaboration with NASA	Investigation of the properties of inter-planetary space between distances of 1 AU and 0.25 AU from the sun: Particles and fields and interactions between them; propagation of shock waves; cosmic dust; relativistic effects; solar-terrestrial phenomena.	Solar wind experiment: Measurement of low-energy charged particles according to their energy levels and distribution in space.	a) MPE b) Rosenbauer	/66
2				Measurement of intensity of the nearly invariant components of the interplanetary magnetic field; measurement of magnetic shock waves.	a) IGMB b) Neubauer	
3				Measurement of the intensity of the interplanetary magnetic field in the frequency range from 0 to 8 Hz.	a) GSFC b) Ness	
4				Measurement of fluctuations in the magnetic field and shock waves.	a) IGMB b) Neubauer, Dehmel	
5				Measurement of the intensity of interplanetary electric fields, radio bursts, shock waves.	a) Univ. of Iowa Univ. of Minnesota GSFC b) Gurnett, Kellogg, Bauer	

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Protons & ions w. energies from 0.2-16keV in each of 32 bands. Particle track experiment 200-770 km/s mass ratio 1 to 5.33 in 25 steps	a) 3 electrostatic analyzers 1 electrodynamic particle-track analyzer b) c) 11.1 kg / 13 W / ≤ 500 bps	b) heliocentric orbit in the ecliptic plane, w. perihelion $\sim 1/4$ AU b) no more than 18 mos. c) spin-stabilized, at 60 rpm	intl. team effort Germany USA Italy Australia	b) Faraday rotation (USA) possible investigations on the corona Follow-on program still has to be analyzed	b) July 1968 c) HELIOS A: 1977 HELIOS B: 1979
$ B \leq 400\gamma$ 0-4.7 Hz (magn. fld. intens.)	a) flux-gate magnetometer to resolve the magnetic elements along the 3 axes. c) 4.8 kg/8.2 W / ≤ 150 bps (shock: ≤ 1000 bps)	d) launches planned: HELIOS A: 1974 HELIOS B: 1975 telemetry data rate: 2048 to 8 bps (depending on distance from the earth)			
$ B \leq 225\gamma$ 0-8 Hz	a) as above, triaxial flux-gate magnetometer c) 3.7 kg / 7.5 W / ≤ 180 bps (shock: ≤ 2000 bps)				
$0.1\gamma\text{Hz} < dB/dt \leq 10^4 \text{ Hz}$ 4.7Hz-3.4kHz	a) induction-coil magnetometer c) 4.0 kg / 5.7W / ≤ 240 bps (shock: ≤ 7000 bps)				
amplitude & frequency spectrum from 0-3 MHz (of the field intensity of the earth's magn. field)	a) radial antenna c) 8.1 kg / 9.3 W / ≤ 700 bps (shock: ≤ 5600 bps)				

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1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
6				Energy spectra, angular distribution in space and time variations associated with high-energy electrons, protons and heavy ions originating in the sun and elsewhere in the galaxy.	a) IKKI b) Hasler, Wibberenz
7				Energy spectra, angular distribution in space and time variations associated with high-energy electrons, protons and heavy ions originating in the sun and elsewhere in the galaxy.	a) GSFC b) Trainor, McDonald
8				Measurement of medium-energy electrons, protons and positrons throughout various energy bands as they are detected coming from various directions in space.	a) MPS b) Keppler
9				Measurement of the zodiacal light as a function of wave-length, polarization and azimuth.	a) MPA b) Leinert
10				Measurements on micrometeorites. (Dual detector system: Sensor #1 is directed to the north of the ecliptic plane, and sensor #2 is directed to the south of it).	a) MPA b) Fechtig
11				Test of the general theory of relativity (by means of a passive experimental set-up).	a) Univ. of Hamburg, Dept. of Theoretical Physics b) Kundt

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B = balloon; S = satellite; P = space sensor; RS = space station

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Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
<p>P: 1MeV-1GeV α: 4MeV-4GeV nucleons w. $Z \leq 10$ as a function of energy, charge, angular dispersion and time e⁻: 0.2-4 MeV</p> <p>particles w. $1 \leq Z \leq 10$ & energies of 0.1-800 MeV e⁻: 0.05 MeV-5 MeV x-rays betw. 1.5A - 12A e⁻: 30keV-1MeV p: 40keV-2.5MeV e⁺: 50-215keV</p> <p>angles betw. photometer axis and the ecliptic: 15°, 30°, 90°</p> <p>mass: 10⁻¹⁵g velocity: 2-100 km/s chemical composition for M=15-70 angle of incidence</p> <p>N/A</p>	<p>a) telescopic type detector (collimated beams) c) 7.8 kg / 7.0 W / ≤ 150 bps</p> <p>a) 4 telescopic type detectors 1 x-ray telescope c) 3.6 kg/ 3.1 W / ≤ 100 bps</p> <p>a) spectrometer c) 3.5 kg / 2.8 W / ≤ 80 bps</p> <p>a) 3 photometers c) 9.2 kg / 9.7W / ≤ 15 bps</p> <p>a) 2 analyzers for micrometeorites c) 10.4 kg / 6.6 W / ≤ 15 bps</p> <p>ground experiment, utilizing a transponder beacon</p>				

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VIII. PROJECT AEROS

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
1	S	AEROS-A, in collaboration with NASA	Aeronomy Satellite Investigation of the relationships between the various states of equilibrium of the upper atmosphere, as this is influenced by short-wave radiation from the sun.	Measurement of the absolute ratio of neutral constituents of the atmosphere and the relative composition of the surrounding ions. The parameters listed below may be derived from the collective evaluation of data obtained with the impedance probe, the reverse-grid analyser and on the temperature of the neutral gases: - Particle density of the neutral components of the atmosphere, - Mass density and average molecular weight of the neutral atmosphere, - Total and partial pressures, - Particle density, mass density and average molecular weight of the ionic constituents.	a) MPK b) Krankowsky
2	S			Measurement of electron density (in support of the other experiments).	a) APW b) Neske, Kist
3	S			Measurement of ion density, of the ionic temperatures, temperature of the electrons, and the energy spectrum of supra-thermal electrons having energies up to 30 eV. Furthermore, the charge accumulated by the satellite will be determined, and observations will be made of any anisotropies occurring in electronic or ionic mobility (mean-free-path data).	a) APW b) Spenner

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Atomic mass region N=1-44 for neutral elements & ions, accuracy: 0.5% ionic current meas. in region from 10^{-17} to 10^{-10} amps; Dynamics $> 10^7$ incident field of view $\pm 18^\circ$.	a) quadripole mass spectrometer b) flight prototype completed c) 5 kg / ~ 10 W / ~ 5 dm ³ / 90 bps orientation is perpendicular to spin axis	a) 800-230 km orbit inclined 97.5° b) 6-9 months c) spin-stabilized at 10 rpm, axis of rotation oriented to sun d) launch: 30 Oct 72 apogee drive motor telemetry data rate: 512 bps		b) res. rocket follow-on program starts 6 weeks after launch of satellite	a) 1 Satellite b) 1968 c) 1974 d) -
$n_e = 10^3$ to 2.4×10^6 / cm ³ accuracy: 10% spatial resolution: 8 km	a) impedance probe b) flight prototype completed c) (w.o. boom) 2.5 kg/ 2.0 W / ~ 3 dm ³ / 16 bps cylindrical detector (w. 150 cm long boom) mounted parallel to axis of rotation.				
T_e, T_i in electron density region of 5×10^2 to 4×10^6 el/cm ³ ; error: $\pm 100^\circ$ incident angle within a $\pm 30^\circ$ region data-gathering interval of 0.5 sec. spatial resolution: 140 km e: 2.5-30 eV for densities greater than 1 el/cm ³	a) reverse-grid analyzer b) flight prototype completed c) 1.4 kg / ~ 1.5 W ~ 2 dm ³ / 65 bps orientation perpendicular to spin axis				

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
4	S			Measurement of the intensity and spectral distribution of solar EUV-radiation in the wavelength region from 155 through 1062 angstroms.	a) APW b) Schmidtke, Schweizer Koch
5	S			Measurement of temperature of the atmosphere, the density of nitrogen in the atmosphere, and the overall density of the neutral atmosphere.	a) GSFC + Univ. of Michigan b) Spencer, Pelz, Newton, Niemann + Carignan, Caldwell
6	S			<u>Passive Experiment:</u> Determination of variations in atmospheric density from orbital data on the satellite.	a) AIB b) Römer

ground observation; F = high altitude aircraft; R = high altitude research rocket;
balloon; S = satellite; P = space sensor; RS = space station

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IX. HELIOS C

Proposed Experiments
and Suggested Tasks

FIELD OF RESEARCH: SUGGESTIONS FOR HELIOS-C

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
1	R	Follow-on to HELIOS-A/B programs, in collaboration with NASA	Pursuit of HELIOS goals comparable to those of HELIOS-A/B	Alternative recommendations, with instrumentation comparable to the HELIOS A/B programs, taking into consideration the orbital period and the sunspot cycle, as follows: a) Satellite mission in the ecliptic plane, with Perihelion: between 0.15 and 0.19 AU Aphelion: 1 AU b) Circular orbit around the sun at a radius between 0.4 and 0.5 AU c) Satellite mission in orbit inclined at more than 25° to the ecliptic plane (from the scientific point of view, this proposal has top priority)	a)/b): Joint Working Group for HELIOS A, April 1971
2	P		Continuation of the HELIOS programs, taking into consideration an extension of studies on galactic and solar cosmic radiation, on interplanetary plasmas and magnetic fields	Instrumentation similar to the HELIOS A/B programs, possibly with omission of measurements on interplanetary dust and meteorites.	a) MPS b) Keppler
3	P		Research on the entropy conditions of interplanetary space, solar effects and interactions with the solar medium.	Observations on <u>solar neutrons</u> using a highly directive neutron monitor (collimated neutron telescope).	a) MPE b) Reppin
4	P	associated with HELIOS C program	Solar-terrestrial phenomena. correlation of measurements taken with a solar space probe, an interplanetary space probe, and an earth-orbiter.	<u>Solar wind experiment</u> : measure measurement of low-energy particles according to their energy and distribution in space, using an earth-tracking space probe that is geosynchronous in regions near the earth's orbit, but which remains outside the magnetosphere and the plasma "tail" of the earth (Magnetopause).	a) MPE b) Rosenbauer

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FIELD OF RESEARCH: SUGGESTIONS FOR HELIOS-C (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
n: 40-150 MeV protons and ions in the energy range of 0.2-16keV, experiment on particle tracks: 260-800 km/s, mass ratio of 1 to 5 e: 1 eV - 1 keV	a) neutron telescope b) further development needed c) a) electrostatic analysers, (electrodynamic) particle track analyzer	a) off-ecliptic mission b) c) d) launch some-time in 1977 a) similar to HELIOS A, but inclined no less than 20° to the ecliptic b) c) d) a) distance from earth's surface greater than 0.1 AE b) c) d)	Prof. White at Univ. of California as with HELIOS A, an intl. cooper. effort is required	a) similar to HELIOS A b) a) as with HELIOS A, possibly without measurements on zodiacal light region b) HELIOS C interplanetary space probe	follow-on to HELIOS program until 1980 a) 1 space probe a) 1 space probe

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X. ASTRONOMICAL SATELLITE A-6

Proposed Experiments and
Definition of Tasks for a
SCOUT Satellite

Program Status: Feasibility Study
is Completed

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
1	S	Project # 625 A-6	X-ray Astronomy: Investigation of cosmic x-radiation from outside the solar system, using high-precision timing methods with medium resolution of spectra; special interest in x-ray pulsars, variable x-ray sources, and supernova-like x-ray bursts.		
2	S	625 A-6	Infra-red Astronomy: Investigation of solutions to problems on evolution of galaxies, structure of galaxies, absorption by interstellar matter, the role various star populations have in the structure of the Milky Way, interstellar dust.	Measurements on luminosity of the night sky, and background cosmic radiation in the IR and UV spectral regions: 1. in the 2-3 and 3-5 micron infra-red regions; 2. in four UV regions: 1700, 2200, 3200 and 5000 Å with filter bandwidths lying between 200 and 300 Angstroms, field of view of the night sky = 1° (solid angle)	a) MPA b) Elsässer, Lemke
3	S	625 A-6	IR/UV Astronomy: Investigation of intensity distribution of selected star fields and interstellar absorption, chemical composition of stellar atmospheres and physical characteristics of the interstellar medium.	Spectroscopic and photometric measurements in the UV and near infra-red spectral regions: 1. High resolution spectroscopic examination of selected individual stars (to an accuracy of about $\leq 5\text{Å}$) in the spectral region between 1100 and 3000 Å, using an integrated lens converter, 2. stepwise wideband, photometric survey of the star field of the night sky in increments of $1.5^\circ \times 1.5^\circ$ frames, using filters with various bandwidths in the 1100 - 4000 Å and 6000 - 12000 Å spectral regions and with the aid of an integrated lens converter.	a) AEB b) Grewing Wulf-Mathies

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B = balloon; S = satellite; P = space sensor; RS = space station

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
<p>X: 0.2-10 keV, and 2 - 20 keV, resolution of energy data in each of 7 to 8 bands, collimator aperture angle less than 3°</p> <p>IR: 2-3μ at temp. of 193° K, 3-5μ at temp. of 90° K</p> <p>UV: 1700, 2200, 3200, 5000Å bandwidth of about 250 Å; field of view less than 1.5°</p> <p>Spectroscopy: UV: 1100-3000Å, resolution, about 5Å</p> <p>Photometry UV: 1100-1800Å, 1600-3000Å, 2200-3000Å; Opt: 3000-4000Å; Far Infra-red: 6000-9000Å, 9000-12000Å;</p> <p>Field of View: 1.5°,</p> <p>Angular resolution of 20"</p>	<p>a) 2 proportional counters (each with 500 cm² effective area), collimator, possibly in this case provided with a gas replenishment system</p> <p>b) equipment design per standard configuration</p> <p>c) ≤ 28 kg / 8-10W / 2 x 26 cu. dm. + 1 x 37 cu. dm. units / ≤ 9000 bps</p> <p>a) 1 or 2 IR reflecting telescopes (23 cm. diam. or 23 & 10 cm. diam. each) w. cooled semiconductor IR detector, 1 UV telescope (10 cm. diam.) w. photomultiplier</p> <p>b) further development of proven techniques</p> <p>c) ≤ 17 kg / 13 W (peak loads of 18 W intermittently) / about 35 cm. diam. by 953 cm. long + 18 cm. diam. by 70 cm. long / about 0.5 bps</p> <p>a) 25 cm. diam. telescope with UV diffraction-grating spectroscope and wideband photometer</p> <p>b) standard configuration</p> <p>c) ≤ 22 kg / 5 W (20 W intermittent peak loads / about 30 cm. diam. by 60 cm. long for the spectroscope and 45 x 20 x 40 cu. cm³ for the photometer / ≤ 10 bps</p>	<p>a) 600/500 km. / 97.5° inclination</p> <p>b) one year</p> <p>c) stabilization in all three axes, accuracy of orbit-alignment - 0.5°</p> <p>d) survey of the galactic disc in a region $\pm 30^\circ$ about the galactic equator, and additionally, several deviations to arbitrarily selected points in the celestial sphere and surveys along profiles from the galactic equator to the poles.</p>			1/83

XI. RECOMMENDATIONS FOR INITIAL DEVELOPMENTAL
EFFORTS, SYSTEMS STUDIES AND FACILITIES DESIGN

RECOMMENDATIONS FOR INITIAL DEVELOPMENTAL
SYSTEM STUDIES AND FACILITIES DESIGN

1	2	3	4	5
Item No.	Area of Application	Description of Proposal	Specifications	Proposal from a) Institute b) Suggestor
1	Ground Systems	Determination of the prerequisites for obtaining an economic solution to data processing problems in the field of space research.		a) MPS b) Keppler
2	Ground Systems	Establishment of a Space Research Data Center for resolution of data handling and data storage problems.		a) MPS b) Keppler
3	Ground Systems	Establishment of a network of ground installations for space object acquisition, tracking and determination of orbital parameters, within the Federal Republic of Germany.		a) MPS b) Keppler
4	Systems Studies	Possibility of using "piggy-back" satellites for small payloads.		a) IKKI b) Wibberenz
5	Research Balloons	Construction of a transportable launching platform for research balloons, for use in equatorial regions and in the southern hemisphere.		a) AIT + MPE b) Trümper + Mayer-Hasselwander
6	Research Balloons	Development of a highly stabilized telescope for use in research balloons (THISBE II feasibility study).		a) MPA b) Elsässer, Lemke
7	Research Balloons	Development of a stabilized platform capable of handling heavy loads, for use in research balloons.	For payloads up to 500 kilograms, with stabilization accuracy of 0.5° to 1°.	a) MPE b) Mayer-Hasselwander
8	Research Balloons	Development of research balloons for long duration and constant level flights.		a) AIT + MPS b) Trümper + Keppler
9	High Altitude Res. Rockets	Improved recovery methods and systems for rocket payloads.		a) MPS b) Keppler
10	Sensors	Development of absolute photometric calibration methods in the infra-red spectral region.		a) MPA b) Elsässer, Lemke
11	Sensors	Further developmental efforts on attitude sensors, especially for high pointing accuracy.		a) MPS b) Keppler
12	Sensors	Development of cooling systems for IR-detectors in satellites.		a) AIB b) Grewing

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RECOMMENDATIONS FOR INITIAL DEVELOPMENTAL
SYSTEM STUDIES AND FACILITIES DESIGN

(Continued)

1	2	3	4	5
Item No.	Area of Application	Description of Proposal	Specifications	Proposal from a) Institute b) Suggestor
13	Sensors	Development of a Giacconi-Walter-Telescope for x-ray astronomy applications, including a suitable image converter.		a) AIT b) Trümper
14	Attitude Control	Further development of attitude control systems for research rockets and satellites (i.e., stabilized platforms).		a) MPS b) Keppler
15	Electronics	Emphasis on development of electronic components, using integrated circuit techniques: a) Current amplifiers and pulse amplifiers. b) High-speed and low-speed analog/digital converters. c) Data storage devices (memory units). d) Multi-purpose, on-board digital computers.		a) MPS b) Keppler

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VI. BIOPHYSICS/BIOLOGY

As most biophysical and biological investigations require recovery, and usually activity by astronauts during the flight, participation in Skylab and in the Post-Apollo program is considered necessary. The previous developmental work for biophysical and biological space flight experiments led to participation in the scientific program of Apollo missions. These experiments require close cooperation with the Manned Spacecraft Center (MSC), NASA, USA.

The Biostack experiment program is being performed in international cooperation.

FIELD OF RESEARCH: BIOPHYSICS/BIOLOGY

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
B 1	T BR RS	a) Apollo Skylab	Changes of terrestrial biological systems in space. Importance: Contamination of other planets, back-contamination of the earth by mutants, sterilization of spaceships and space probes. Radiation biology.	Investigation of the mechanism of action of space factors on biopolymers and microorganisms (Enzymes, nucleic acids, bacteriophages, bacteria)	a) ABR b) Bucker Horneck
B 2	T BR RS	a) Apollo Skylab PAP	Changes in biological systems due to cosmic radiation. Importance: Contribution to radiation biology; evaluation of danger to humans in space flight and in the SST.	BIOSTACK, Study of the effect and the mechanism of action of heavy primaries of cosmic radiation on biological objects. Objects: Bacteriophage, bacterial spores, plant seeds, animal eggs. Physical detectors: Nuclear track emulsions, plastic detectors, silver chloride crystals, thermoluminescence dosimeter. The experiment is being performed in the Federal Republic of Germany by: ABR Horneck IKKI Allkofer .. Bartholoma Beaujean Enge Röhrs ISH Scheuermann KIF Schopper Henig Schott MPB Reinholz NUCMED Graul Rüther	a) ABR b) Bucker (Principal Investigator)
B 3	T B		Genetic changes of biological systems in space. Importance: Evaluation of danger to humans in space flight and supersonic flight (SST).	Study of the biological action of the heavy primary particles of cosmic radiation on marine crab eggs. <u>1st phase:</u> irradiation with heavy ions in an accelerator <u>2nd phase:</u> irradiation with heavy primary particles of cosmic radiation in a balloon experiment	a) NUCMED + IKKI b) Graul Allkofer Rüther Heinrich

T = ground observation; F = high altitude aircraft; R = high altitude research rocket;
B = balloon; S = satellite; P = space sensor; RS = space station

FIELD OF RESEARCH: BIOPHYSICS/BIOLOGY (Continued)

7	8	9	10	11	12
Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
Vacuum, cosmic radiation, visual solar radiation, temperature	a) MEED M-191 (NASA) b) flight-ready	a) beyond 100 km b) beyond 10 minutes d) recovery	Existing, with Manned Spacecraft Center (MSC) NASA, USA		b) First flight with Apollo 16; other flights being planned
Heavy cosmic radiation primaries	a) BIOSTACK M-211 b) flight-ready c) 2 kg	a) "Deep space mission," orbital and balloon flights Altitude ≤ 10 g/m ² b) 3 to 56 days d) recovery	Existing, with NASA, USA, "Working group on space biophysics"; Council of Europe, CNES, France		a) First space flight with Apollo 16 b) Balloon flights since 1971 c) International research program with space flights, balloon flights, and accelerator experiments
<u>1st phase:</u> irradiation with 10.2 MeV/N, $Z \leq 6$ <u>2nd phase:</u> irradiation with 200 MeV/N, $Z \leq 6$	Multilayer detector (1 m ² area)	<u>2nd phase</u> a) Altitude ≤ 10 g/cm ² b) c) d) Launch from Kiruna, recovery	1. Accelerator in USA 2. Balloon launch group of the IKKI		<u>2nd phase</u> a) 3 balloons in one mission

1	2	3	4	5	6
Item No. of proposal	Technological area of application	Relationship to or contribution to applicable program a) program b) associated program	Scientific area of investigation and its significance	Scientific goal established for the experiment proposed	Proposal from a) institute b) suggestor
B 4	R RS		Physiological and metabolic changes in biological systems during space flight. Importance: effect on cellular metabolism during the launch phase and space flight.	Study of the mechanism of action of space flight factors on cellular metabolism. Objects: luminous bacteria.	a) ABR b) Bucker Horneck
B 5	RS		Genetic and physiological-metabolic changes in biological systems during space flight. Importance: effect of gravity on the development of biological objects.	Long-term effect of weightlessness, in part combined with radiation, on the development of several successive generations in orbit. Object: Drosophila	a) ABR MPB b) Bucker Reinhold
B 6	RS		Genetic and physiological-metabolic changes in the biological system during space flight. Importance: effect of weightlessness on the hormone balance of astronauts.	Effect of long-term residence in a weightless state on the activity of the adrenal cortex, perhaps in combination with radiation. Objects: rats	a) RIF b) Flemming
B 7	RS		Genetic and metabolic-physiological changes in the biological system during space flight. Importance: genetic changes in astronauts during long-term residence in space, problems of radiation biology.	Effect of weightlessness in combination with radiation on oogenesis and spermatogenesis of mammals (point mutations and chromosome aberrations). Objects: Chinese hamsters, mice	a) IHF b) Degenhardt
B 8	R S RS		Genetic and metabolic-physiological changes in the biological system during space flight.	Effect of space flight factors on the metabolism of biological objects. Objects: leech	a) FEBF b) Lotz
B 9	R RS		Occurrence of prebiotic molecules in space. Importance: origin of life, environmental research (orbital contamination and climatic changes).	Search for organic molecules in orbit: a) Free, low-molecular-weight, organic molecules b) Higher molecular weight, organic molecules on dust particles and micrometeorites.	a) MPB + ABR b) Dose, Bucker

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B = balloon; S = satellite; P = space sensor; RS = space station

Range of observations	Experiment a) instrumentation b) developmental status c) weight/power/dimensions/data rate (data associated with payloads)	Task requirements a) orbit/height/inclination b) task duration c) orientation d) other data - launch date, recovery, needs, etc.	Collaboration, existing or to be arranged with other agencies	Desired auxiliary experiment a) in same payload b) for follow-on program	Program schedule a) No. of launches b) start of project c) duration of project d) limitations on project
UV radiation	a) LUCIFER Measurement of bacterial luminescence.	Low orbit Manned activity			Planned for post-Apollo Program
Weightlessness	Development for space station required.	Low orbit 56 days - 3 year Recovery Manned activity	Existing, with Space Physiology Group, Council of Europe. Being attempted with NASA, USA		Planned for post-Apollo Program
Weightlessness	Development for space station necessary.	Low orbit 28 days - 1 year Recovery Manned activity	Existing, with Space Physiology Group, Council of Europe. Is being attempted with NASA, USA		Planned for post-Apollo Program
Weightlessness	Development for space station needed.	Low orbit 28 days - 1 year Recovery Manned activity	Existing, with Space Physiology Group, Council of Europe. Is being attempted with NASA, USA		Planned for post-Apollo Program
	a) Automatic Bioprobe Development required for space station	Orbit and space probes	Existing with institutes in the USA		Planned for post-Apollo Program